Please amend claims 40 and 69 as shown in the attached Appendix and add new claims 77-167. All pending claims as so amended follow.

36. A method for reducing voids in a metal material that has been electrolytically deposited into recessed microstructures defined in a surface of a microelectronic workpiece comprising:

electrolytically depositing a metal to substantially fill recessed sub-micron structures in the surface of the workpiece; and then

subjecting the workpiece to an annealing process at a temperature that is at or below about 250 degrees Celsius.

37. A method as set forth in Claim 36 wherein the metal material comprises copper.

38. A method as set forth in Claim 36 wherein the annealing process comprises subjecting the workpiece to a controlled temperature gradient in which the temperature decreases along a cross-section of the workpiece in a direction that is opposite to the direction of formation of the metal material during its deposition.

39. A method as set forth in Claim 37 wherein the annealing process comprises subjecting the workpiece to a controlled temperature gradient in which the temperature decreases along a cross-section of the workpiece in a direction that is opposite to the direction of the formation of the deposited metal material.

40. (Twice Amended) A method for reducing voids in a metal material that has been electrolytically deposited into recessed microstructures defined on a surface of a microelectronic workpiece comprising:

electrolytically depositing a metal to substantially fill recessed sub-micron structures on the surface of the workpiece; and then

subjecting the workpiece to an annealing process to generate a controlled temperature gradient in which the temperature decreases along a cross-section of the

workpiece in a direction that is toward the surface in which the recessed sub-micron structures are formed.

68. A method for reducing voids in a metal material that has been electrolytically deposited into recessed microstructures defined in a surface of a microelectronic workpiece including at least one low-K dielectric layer, comprising:

electrolytically depositing a metal to substantially fill sub-micron recessed structures on the surface of the workpiece; and

subjecting the surface of the workpiece to an elevated temperature annealing process at a temperature that is selected to be below a predetermined temperature at which the low-K dielectric layer would suffer degradation of its mechanical and/or electrical properties.

69. (Amended) A method for reducing voids in copper metal that has been electrolytically deposited into recessed microstructures defined in a surface of a microelectronic workpiece comprising:

electrolytically depositing copper metal to substantially fill sub-micron recessed structures in the surface of the workpiece and

then subjecting the surface of the workpiece to an annealing process at a temperature that is at or below about 300 degrees Celsius.

70. A method for reducing voids in a metal material that has been electrochemically deposited into recessed microstructures defined in a surface of a microelectronic workpiece comprising:

electrochemically depositing a metal to substantially fill sub-micron recessed structures in the surface of the workpiece; and

subjecting the workpiece with deposited metal to an elevated temperature annealing process within a chamber, followed by subjecting the workpiece with deposited metal to a cooling process within the chamber.

71. The method of Claim 36, further comprising depositing a barrier layer on the surface of the workpiece in which the recessed microstructures are formed prior to depositing metal to substantially fill the recessed microstructures.

72. The method of Claim 71, further comprising depositing a seed layer, substantially comprised of the same metal to be deposited to substantially fill the recessed microstructures, onto the surface of the workpiece prior to depositing the metal to substantially fill the recessed microstructures.

73. The method of Claim 36, further comprising depositing a seed layer, substantially comprised of the same metal to be deposited to substantially fill the recessed microstructures, onto the surface of the workpiece prior to depositing the metal to substantially fill the recessed microstructures.

74. The method of Claim 69, further comprising depositing a barrier layer on the surface of the workpiece in which the recessed microstructures are formed prior to depositing metal to substantially fill the recessed microstructures.

75. The method of Claim 74, further comprising depositing a seed layer, substantially comprised of the same metal to be deposited to substantially fill the recessed microstructures, onto the surface of the workpiece prior to depositing the metal to substantially fill the recessed microstructures.

76. The method of Claim 69, further comprising depositing a seed layer, substantially comprised of the same metal to be deposited to substantially fill the recessed microstructures, onto the surface of the workpiece prior to depositing the metal to substantially fill the recessed microstructures.

77. (New) A method of thermally treating a surface of a microelectronic workpiece, comprising:

electroplating copper metal to substantially fill recessed sub-micron structures in the surface of the workpiece; then

generating a controlled temperature gradient through the electroplated copper in which the temperature decreases along a cross-section of the workpiece in a direction that is opposite to the direction of formation of the metal material during its electroplating.

78. (New) The method of Claim 77 wherein a maximum temperature of the temperature gradient is at or below about 300 degrees Celsius.

79. (New) The method of Claim 77 wherein a maximum temperature of the temperature gradient is at or below about 250 degrees Celsius.

80. (New) The method of Claim 77 wherein a maximum temperature of the temperature gradient is at or below about 100 degrees Celsius.

81. (New) The method of Claim 77 wherein a maximum temperature of the temperature gradient is between about 60 degrees Celsius and about 100 degrees Celsius.

82. (New) The method of Claim 77 wherein the temperature gradient induces a stress gradient in the electroplated copper.

83. (New) The method of Claim 77 wherein the workpiece is subjected to the temperature gradient for no longer than 15 minutes.

84. (New) The method of Claim 77 wherein the workpiece is subjected to the temperature gradient for less than one minute.

85. (New) The method of Claim 77 wherein the temperature gradient is established by heating the workpiece from a back surface opposite the surface including the recessed sub-micron structures.

86. (New) The method of Claim 77 wherein electroplating the copper metal comprises contacting the surface of the workpiece with a copper-containing electroplating solution and applying electroplating power.

87. (New) The method of Claim 86 wherein the electroplating power is initially applied at a first current for a predetermined first period of time, then applied at a higher second current for a predetermined second period of time.

88. (New) The method of Claim 86 wherein the surface of the workpiece is contacted with the electroplating solution for a predetermined dwell period before the electroplating power is applied.

89. (New) The method of Claim 86 wherein the electroplating power is applied as a direct current.

90. (New) The method of Claim 86 wherein the electroplating power is applied as a pulsed waveform at a frequency of between 1 and 1000 Hz.

91. (New) The method of Claim 90 wherein the frequency of the pulsed waveform is between 5 and 20 Hz with a duty cycle of at least 50 percent.

92. (New) The method of Claim 86 wherein the workpiece is spun while electroplating power is applied.

93. (New) The method of Claim 77 wherein the copper is electroplated for a sufficient period of time to deposit excess copper above the recessed sub-micron structures.

94. (New) The method of Claim 93 further comprising removing the excess copper after the workpiece is subjected to the temperature gradient.

95. (New) The method of Claim 94 wherein the excess copper is removed via chemical mechanical polishing.

96. (New) The method of Claim 94 wherein the temperature gradient induces a stress gradient in the electroplated copper.

97. (New) A method of treating a microelectronic workpiece having a body and a surface bearing recessed sub-micron structures, comprising:

electroplating copper metal to substantially fill the recessed sub-micron structures; then

generating a temperature gradient through the electroplated copper in which the temperature decreases along a cross-section of the workpiece in a direction moving outwardly from the body toward the surface.

98. (New) The method of Claim 97 wherein a maximum temperature of the temperature gradient is at or below about 300 degrees Celsius.

99. (New) The method of Claim 97 wherein a maximum temperature of the temperature gradient is at or below about 250 degrees Celsius.

100. (New) The method of Claim 97 wherein a maximum temperature of the temperature gradient is at or below about 100 degrees Celsius.

101. (New) The method of Claim 97 wherein a maximum temperature of the temperature gradient is between about 60 degrees Celsius and about 100 degrees Celsius.

102. (New) The method of Claim 97 wherein the temperature gradient induces a stress gradient in the electroplated copper.

103. (New) The method of Claim 97 wherein the workpiece is subjected to the temperature gradient for no longer than 15 minutes.

104. (New) The method of Claim 97 wherein the workpiece is subjected to the temperature gradient for less than one minute.

105. (New) The method of Claim 97 wherein the temperature gradient is established by heating the workpiece from a back surface opposite the surface including the recessed sub-micron structures.

106. (New) The method of Claim 97 wherein electroplating the copper metal comprises contacting the surface of the workpiece with a copper-containing electroplating solution and applying electroplating power.

107. (New) The method of Claim 106 wherein the electroplating power is initially applied at a first current for a predetermined first period of time, then applied at a higher second current for a predetermined second period of time.

108. (New) The method of Claim 106 wherein the surface of the workpiece is contacted with the electroplating solution for a predetermined dwell period before the electroplating power is applied.

109. (New) The method of Claim 106 wherein the electroplating power is applied as a direct current.

110. (New) The method of Claim 106 wherein the electroplating power is applied as a pulsed waveform at a frequency of between 1 and 1000 Hz.

111. (New) The method of Claim 110 wherein the frequency of the pulsed waveform is between 5 and 20 Hz with a duty cycle of at least 50 percent.

112. (New) The method of Claim 106 wherein the workpiece is spun while electroplating power is applied.

113. (New) The method of Claim 97 wherein the copper is electroplated for a sufficient period of time to deposit excess copper above the recessed sub-micron structures.

114. (New) The method of Claim 113 further comprising removing the excess copper after the workpiece is subjected to the temperature gradient.

115. (New) The method of Claim 114 wherein the excess copper is removed via chemical mechanical polishing.

116. (New) The method of Claim 114 wherein the temperature gradient induces a stress gradient in the electroplated copper.

117. (New) A method of processing a microelectronic workpiece having a surface including a sub-micron recessed microstructure, comprising:

electroplating copper at an electroplating station to substantially fill the recessed microstructure and to deposit excess copper above the recessed microstructure;

thereafter, robotically transferring the workpiece from the electroplating station for at least one further process that includes thermal processing at a thermal processing station, the thermal processing comprising thermally treating the electroplated copper by establishing a temperature gradient through the electroplated copper having a maximum gradient temperature of about 60 degrees Celsius to about 100 degrees Celsius for no longer than 15 minutes, thereby reducing resistivity of the copper and reducing voids which may be present in the copper.

118. (New) The method of Claim 117 further comprising removing the excess copper after the thermal processing.

119. (New) The method of Claim 118 wherein the excess copper is removed via chemical mechanical polishing.

120. (New) The method of Claim 117 wherein the workpiece is thermally treated with a plurality of other workpieces in batch processing fashion.

121. (New) The method of Claim 117 wherein the workpiece is thermally treated by flowing a temperature-controlled fluid over a surface of the workpiece.

122. (New) The method of Claim 121 wherein the temperature-controlled fluid comprises a gas.

123. (New) The method of Claim 121 wherein the temperature-controlled fluid comprises a cooling fluid.

124. (New) The method of Claim 117 wherein the workpiece is thermally treated by radiant heating.

125. (New) The method of Claim 117 wherein the workpiece is thermally treated by a hot plate.

126. (New) The method of Claim 117 further comprising sensing a control temperature and controlling heating of the workpiece in response to the sensed temperature.

127. (New) The method of Claim 126 wherein the control temperature is a temperature of a coolant fluid after the fluid is brought into thermal contact with the workpiece.

128. (New) The method of Claim 117 wherein the temperature in the temperature gradient decreases in a direction outwardly from the filled recessed microstructure toward the excess copper.

129. (New) The method of Claim 117 wherein the temperature gradient induces a stress gradient in the electroplated copper.

130. (New) A method of treating a workpiece having a base having a surface, a dielectric layer carried on the surface of the base, and recessed sub-micron structures formed in the dielectric layer, comprising:

depositing a conductive seed layer exterior to the dielectric layer and in the recessed sub-micron structures;

contacting the seed layer with a copper-containing electroplating solution;

applying electroplating power to the seed layer to electrolytically deposit copper metal from the electroplating solution to substantially fill the recessed sub-micron structures and to deposit excess copper metal which extends beyond an exterior surface of the dielectric layer; then

subjecting the electroplated workpiece to an elevated temperature annealing process comprising establishing a temperature gradient in which the temperature decreases in a direction moving outwardly from the base toward the dielectric layer, the annealing process having a maximum gradient temperature which is no greater than about 250 degrees Celsius.

131. (New) The method of Claim 130 wherein the maximum temperature of the annealing process is at or below about 100 degrees Celsius.

132. (New) The method of Claim 130 wherein the maximum temperature of the annealing process is between about 60 degrees Celsius and about 100 degrees Celsius.

133. (New) The method of Claim 130 wherein the workpiece is subjected to the annealing process for no longer than 15 minutes.

134. (New) The method of Claim 130 wherein the workpiece is subjected to the annealing process for less than one minute.

135. (New) The method of Claim 130 further comprising depositing a barrier layer on the dielectric layer and in the sub-micron structures prior to depositing the seed layer.

136. (New) The method of Claim 130 wherein the temperature gradient induces a stress gradient in the electroplated copper.

137. (New) The method of Claim 130 wherein the electroplating power is initially applied at a first current for a predetermined first period of time, then applied at a higher second current for a predetermined second period of time.

138. (New) The method of Claim 130 wherein the electroplating power is applied as a direct current.

139. (New) The method of Claim 130 wherein the electroplating power is applied as a pulsed waveform at a frequency of between 1 and 1000 Hz.

140. (New) The method of Claim 139 wherein the frequency of the pulsed waveform is between 5 and 20 Hz with a duty cycle of at least 50 percent.

141. (New) The method of Claim 130 wherein the workpiece is spun while electroplating power is applied.

142. (New) The method of Claim 130 further comprising removing the excess copper after the workpiece is subjected to the elevated temperature annealing process.

143. (New) A method of treating a microelectronic workpiece having a base having a surface including a sub-micron recessed microstructures, comprising:

contacting the surface of the workpiece with a copper-containing electroplating solution;

applying electroplating power at a first power level for a predetermined first period of time, then applying electroplating power at a higher second power level for a time sufficient to substantially fill the recessed sub-micron structures with electroplated copper metal and to deposit excess copper metal above the sub-micron recessed microstructures; then

subjecting the electroplated workpiece to an elevated temperature annealing process comprising establishing a temperature gradient through the electroplated copper metal in which the temperature decreases in a direction moving outwardly from the base toward the workpiece surface, the annealing process having a maximum gradient temperature which is no greater than about 250 degrees Celsius.

144. (New) The method of Claim 143 wherein the maximum temperature of the annealing process is at or below about 100 degrees Celsius.

145. (New) The method of Claim 143 wherein the maximum temperature of the annealing process is between about 60 degrees Celsius and about 100 degrees Celsius.

146. (New) The method of Claim 143 wherein the workpiece is subjected to the annealing process for no longer than 15 minutes.

147. (New) The method of Claim 143 wherein the workpiece is subjected to the annealing process for less than one minute.

148. (New) The method of Claim 143 further comprising depositing a barrier layer on the dielectric layer and in the sub-micron structures prior to depositing the seed layer.

149. (New) The method of Claim 143 wherein the temperature gradient induces a stress gradient in the electroplated copper.

150. (New) The method of Claim 143 wherein the seed layer is contacted with the electroplating solution for a predetermined dwell period before the electroplating power is applied.

151. (New) The method of Claim 143 wherein the electroplating power is applied as a direct current.

152. (New) The method of Claim 143 wherein the electroplating power is applied as a pulsed waveform at a frequency of between 1 and 1000 Hz.

153. (New) The method of Claim 152 wherein the frequency of the pulsd waveform is between 5 and 20 Hz with a duty cycle of at least 50 percent.

154. (New) The method of Claim 143 wherein the workpiece is spun while electroplating power is applied.

155. (New) The method of Claim 143 further comprising removing the excess copper after the workpiece is subjected to the elevated temperature annealing process.

156. (New) A method of treating a microelectronic workpiece having a base having a surface including a sub-micron recessed microstructures, comprising:

contacting the surface of the workpiece with a copper-containing electroplating solution;

applying electroplating power to the workpiece in a pulsed waveform having a frequency of between about 1 and 1000 Hz to substantially fill the recessed sub-micron structures with electroplated copper metal and to deposit excess copper metal above the sub-micron recessed microstructures; then

subjecting the electroplated workpiece to an elevated temperature annealing process comprising establishing a temperature gradient through the electroplated copper in which the temperature decreases in a direction moving outwardly from the base toward the surface of the workpiece, the temperature gradient having a maximum gradient temperature which is no greater than about 250 degrees Celsius.

157. (New) The method of Claim 156 wherein the frequency of the pulsed waveform is between 5 and 20 Hz with a duty cycle of at least 50 percent.

158. (New) The method of Claim 156 wherein the maximum temperature of the annealing process is at or below about 100 degrees Celsius.

159. (New) The method of Claim 156 wherein the maximum temperature of the annealing process is between about 60 degrees Celsius and about 100 degrees Celsius.

160. (New) The method of Claim 156 wherein the workpiece is subjected to the annealing process for no longer than 15 minutes.

161. (New) The method of Claim 156 wherein the workpiece is subjected to the annealing process for less than one minute.

162. (New) The method of Claim 156 wherein a dielectric is carried on a surface of the base, the sub-micron recessed microstructures being formed in the dielectric layer, the method further comprising depositing a conductive seed layer exterior to the dielectric layer and in the sub-micron recessed microstructures.

163. (New) The method of Claim 162 further comprising depositing a barrier layer on the dielectric layer and in the sub-micron structures prior to depositing the seed layer.

164. (New) The method of Claim 162 wherein the electroplating power is applied to the seed layer.

165. (New) The method of Claim 156 wherein the temperature gradient induces a stress gradient in the electroplated copper.

166. (New) The method of Claim 156 wherein the seed layer is contacted with the electroplating solution for a predetermined dwell period before the electroplating power is applied.

167. (New) The method of Claim 156 wherein the electroplating power is applied as a direct current.

168. (New) The method of Claim 156 wherein the electroplating power is initially applied at a first current for a predetermined first period of time, then applied at a higher second current for a predetermined second period of time.

169. (New) The method of Claim 156 wherein the workpiece is spun while electroplating power is applied.

170. (New) The method of Claim 156 further comprising removing the excess copper after the workpiece is subjected to the elevated temperature annealing process.

171. (New) A method of processing a microelectronic workpiece having a surface including a sub-micron recessed microstructure and a conductive seed layer in the sub-micron recessed microstructure, comprising:

electroplating copper at an electroplating station to substantially fill the recessed microstructure and to deposit excess copper which extends above the sub-micron recessed microstructure;

robotically transferring the workpiece from the electroplating station for further processing;

removing the excess copper as one of the further processes; and

thereafter, robotically transferring the workpiece to a thermal processing station to thermally treat the electroplated copper by establishing a temperature gradient in the electroplated copper having a maximum temperature of about 60 degrees Celsius to about 100 degrees Celsius for no longer than 15 minutes, thereby reducing resistivity of the copper and reducing voids which may be present in the copper.

172. (New) The method of Claim 171 wherein the excess copper is removed via chemical mechanical polishing.

173. (New) The method of Claim 171 wherein the microelectronic workpiece is thermally treated with a plurality of other semiconductor workpieces in batch processing fashion.

174. (New) The method of Claim 171 wherein the microelectronic workpiece is thermally treated by flowing a temperature-controlled fluid over a surface of the workpiece.

175. (New) The method of Claim 174 wherein the temperature-controlled fluid comprises a gas.

176. (New) The method of Claim 174 wherein the temperature-controlled fluid comprises a cooling fluid.

177. (New) The method of Claim 171 wherein the semiconductor workpiece is thermally treated by radiant heating.

178. (New) The method of Claim 171 wherein the semiconductor workpiece is thermally treated by a hot plate.

179. (New) The method of Claim 171 further comprising sensing a control temperature and controlling heating of the workpiece in response to the sensed temperature.

180. (New) The method of Claim 179 wherein the control temperature is a temperature of a coolant fluid after the fluid is brought into thermal contact with the workpiece.

181. (New) The method of Claim 171 wherein the temperature in the temperature gradient decreases in a direction outwardly from the filled recessed microstructure toward the excess copper.

182. (New) The method of Claim 171 wherein the temperature gradient induces a stress gradient in the electroplated copper.

183. (New) A method of processing a workpiece and an integrated processing tool having an electroplating station, a thermal processing station, and a robotic transfer device, the workpiece having a surface including sub-micron recessed microstructures, the method comprising: